SOLAR/1057-78/10

Monthly Performance Report

ZEIN MECHANICAL CONTRACTORS NO. 1

OCTOBER 1978

U.S. Department of Energy

National Solar Heating and Cooling Demonstration Program

National Solar Data Program

MONTHLY PERFORMANCE REPORT

ZEIN MECHANICAL CONTRACTORS NO. 1

OCTOBER 1978

I. SYSTEM DESCRIPTION

Zein Mechanical Contractors No. 1 is a single family residence in Milwaukee, Wisconsin. The home has approximately 1304 square feet of conditioned space. The solar energy system consists of two independently controlled systems: one system serves domestic hot water (DHW) preheating, the other is used for space heating and space cooling. Only the space heating and cooling system is described in this report.

The system has an array of flat-plate collectors with a gross area of 384 square feet. The array faces south at an angle of 53 degrees to the horizontal. Air is the transfer medium that delivers solar energy from the collector array to storage. Solar energy is stored in a rock bin containing 41,250 pounds of rock located in the basement of the house. The rock bin has 2 inches of polyurethane insulation on the outside walls and fiberglass roll insulation in the ceiling. A heat pump delivers solar energy from storage to a heat exchanger located within an air-handler. Heated air is then blown from the air-handler to the load. When solar energy is insufficient to satisfy the space heating load, an electric resistance heater in the air-handler provides auxiliary energy for space heating. The system, shown schematically in Figure 1, has 10 modes of solar operation for space conditioning.

Mode 1 - Storage-to-Heat Pump-to-Space Heating: This winter mode activates when there is a demand for space heating, the collector loop is not active, and the outside ambient temperature is less than 10°F above the rock bed temperature. Air is drawn through motorized dampers from storage by the collector/heat pump circulating fan, past the heat pump evaporator coil, bypassing the collector, and returns to storage. The heat pump condenser coil and house circulating fan supply energy to the house and electrical strip heaters supplement the heat pump to meet the heating demand.

Mode 2 - Collector-to-Storage: This winter mode activates when the temperature difference between the collector outlet and storage is 10°F or higher, and the outside ambient temperature is less than 10°F above the rock bed temperature. Air is drawn from the collector by the collector/heat pump circulating fan and goes into the rock bin through motorized dampers and then recirculates through the collector. There may or may not be a demand for space heating.

Mode 3 - Outside Air-to-Rock Bed: This mode activates when the collector loop is inactive, there is no demand for space heating, and the outside ambient temperature is higher than 10°F above the rock bed temperature. Air is drawn from the outside by the collector/heat pump circulating fan and goes into the rock bin through motorized dampers and then exhausts to the outside through a backdraft damper in the wall of the insulated room.

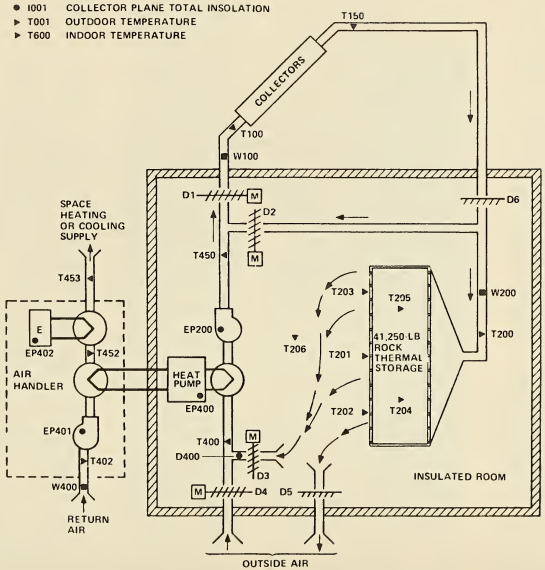

Figure 1. ZEIN MECHANICAL NO. 1 SOLAR ENERGY SYSTEM SCHEMATIC

Mode 4 - Outside Air-to-Heat Pump-to-Space Heating: This winter mode activates when there is a demand for space heating, the collector loop is not active, and the outside ambient temperature is more than 10°F above the rock bed temperature. Air is drawn from the outside through motorized dampers, past the heat pump evaporator coil, through the storage bin, and then exhausts to the outside through a backdraft damper in the wall of the insulated room. The heat pump condenser coil and house circulating fan supply energy to the house. Electric strip heaters supplement the heat pump to meet the heating demand.

Mode 5 - Outside Air-to-Collector-to-Rock Bed: This mode activates when the difference in temperature between the collector outlet and storage is 10°F or higher, and the outside ambient temperature is more than 10°F above the rock bed temperature. Air is drawn from the outside by the collector/ heat pump circulating fan, goes through the collector and into the rock bin through motorized dampers, and then exhausts to the outside. There may or may not be a demand for space heating.

Mode 6 - Storage-to-Heat Pump-to-Space Cooling: This summer mode activates when there is a demand for space cooling, the collector loop is not active, and the rock bed temperature is less than 10°F above the outside ambient temperature. Air is drawn through motorized dampers from storage by the collector/heat pump fan, past the heat pump condenser coil, bypassing the collector, and returns to storage. The heat pump evaporator coil and house circulating fan remove energy from the house.

Mode 7 - Collector-to-Storage for Cooling: This mode rejects rock bed energy by circulating air through the collector at night. This summer mode activates when the temperature difference between the rock bed and the collector outlet is 10°F or higher, and the rock bed temperature is less than 10°F above the outside ambient temperature. Air is drawn from the collector at night by the collector/heat pump circulating fan and goes into the rock bin through motorized dampers and then recirculates through the collector. There may or may not be a demand for space cooling.

Mode 8 - Outside Air-to-Rock Bed for Cooling: This mode activates when the collector loop is inactive, there is no demand for space cooling, and the rock bed temperature is more than 10°F above the outside ambient temperature. Air is drawn from the outside by the collector/heat pump circulating fan and goes into the rock bin through motorized dampers and then exhausts to the outside through a backdraft damper in the wall of the insulated room.

Mode 9 - Outside Air-to-Heat Pump-to-Space Cooling: This summer mode activates when there is a demand for space cooling, the collector loop is not active, and the rock bed temperature is more than 10°F above the outside ambient temperature. Air is drawn from the outside through motorized dampers to the heat pump, past the heat pump condenser coil, through the storage bin, and then exhausts to the outside through a backdraft damper in the wall of the insulated room. The heat pump evaporator coil and house circulating fan remove energy from the house to meet the cooling load.

Mode 10 - Outside Air-to-Collector-to-Rock Bed: This mode activates when the temperature difference between the rock bed and collector outlet is 10°F or

higher, and the rock bed temperature is higher than 10°F above the outside ambient temperature. Air is drawn from the outside by by the collector/ heat pump circulating fan, goes into the rock bin through motorized dampers, and is then exhausted to the outside. There may or may not be a demand for space cooling.

II. PERFORMANCE EVALUATION

INTRODUCTION

The site was unoccupied in October; however, the solar energy system operated continuously during the month. Solar energy satisfied 49 percent of the space heating requirements. The solar energy system incurred an electrical energy expense of 0.16 million Btu.

WEATHER CONDITIONS

During the month, total incident solar energy on the collector array was 14.2 million Btu for a daily average of 1190 Btu per square foot. This was below the estimated average daily solar radiation for this geographical area during October of 1338 Btu per square foot for a south-facing plane with a tilt of 53 degrees to the horizontal. The average ambient temperature during October was 50°F as compared with the long-term average for October of 51°F.

THERMAL PERFORMANCE

Collector - The total incident solar radiation on the collector array for the month of October was 14.2 million Btu. During the period the collector loop was operating the total insolation amounted to 13.7 million Btu. The total collected solar energy for the month of October was 6.1 million Btu, resulting in a collector array efficiency of 43 percent, based on total incident insolation. Solar energy delivered from the collector array to storage was 6.1 million Btu. Operating energy required by the collector loop was 0.29 million Btu.

Storage - Solar energy delivered to storage was 6.1 million Btu. There were 0.23 million Btu delivered from storage to the space heating system. Energy loss from storage was 5.8 million Btu. This loss represented 95 percent of the energy delivered to storage. The storage efficiency was 5 percent: This is calculated as the ratio of the sum of the energy removed from storage and the change in stored energy, to the energy delivered to storage. The average storage temperature for the month was 92°F.

Space Heating Load - The space heating system consumed 0.23 million Btu of solar energy and 0.25 million Btu of auxiliary electrical energy to satisfy a space heating load of 0.48 million Btu. The solar fraction of this load was 49 percent. The space heating system consumed a total of 0.15 million Btu of operating energy, resulting an an electrical energy savings of 0.13 million Btu.

OBSERVATIONS

The large storage losses are attributed to leakage from the collector loop which caused make-up air to be drawn into the insulated room through the outside air vents.

ENERGY SAVINGS

The solar energy system provided a net electrical energy expense of 0.16 million Btu. The space heating system contributed an electrical energy savings of 0.13 million Btu.

III. ACTION STATUS

No action is planned.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: ZEIN MECHANICAL-NO. 1
REPORT PERIOD: OCTOBER,1978

SOLAR/1057-78/10

SITE/SYSTEM DESCRIPTION:
THE ZEIN MECHANICAL NO. 1 SOLAR ENERGY SYSTEM UTILIZES A SOLAR ASSISTED HEAT PUMP TO HEAT AND COOL A 1304 SQ FT SINGLE FAMILY DWELLING. THE COLLECTION SUBSYSTEM CONSISTS OF 384 SQ FT OF AIR COLLECTORS, TILTED AT 53 DEGREES, TO COLLECT SOLAR ENERGY DURING THE WINTER AND REJECT HEAT PUMP COOLING ENERGY DURING THE SUMMER. A 40 TON ROCK BED IS USED FOR STORAGE. AUXILIARY HEATING IS SUPPLIED BY THE HEAT PUMP WHICH CONTAINS AN ELECTRIC STRIP HEATER.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	14.168	MILLION BTU
	36896	BTU/SQ.FT.
COLLECTED SOLAR ENERGY	6.081	MILLION BTU
	15836	BTU/SQ.FT.
AVERAGE AMBIENT TEMPERATURE	50	DEGREES F
AVERAGE BUILDING TEMPERATURE	68	DEGREES F
ECSS SOLAR CONVERSION EFFICIENCY	0.02	
ECSS OPERATING ENERGY	0.290	MILLION BTU
TOTAL SYSTEM OPERATING ENERGY	0.440	MILLION BTU
TOTAL ENERGY CONSUMED	6.771	MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	N.A.	0.484	N.A.	0.484 MILLION BTU
SOLAR FRACTION	N.A.	49	N.A.	49 PERCENT
SOLAR ENERGY USED	N.A.	0.234	N.A.	0.234 MILLION BTU
OPERATING ENERGY	N.A.	0.151	N.A.	0.440 MILLION BTU
AUX. THERMAL ENERGY	N.A.	0.249	N.A.	0.249 MILLION BTU
AUX. ELECTRIC FUEL	N.A.	0.249	N.A.	0.249 MILLION BTU
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. MILLION BTU
ELECTRICAL SAVINGS	N.A.	0.129	N.A.	-0.161 MILLION BTU
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. MILLION BTU

SYSTEM PERFORMANCE FACTOR: 0.211

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: ZEIN MECHANICAL-NO. 1
REPORT PERIOD: OCTOBER, 1978

SOLAR/1057-78/10

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GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	14.947 GIGA JOULES
	418989 KJ/SQ.M.
COLLECTED SOLAR ENERGY	6.415 GIGA JOULES
	179832 KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	10 DEGREES C
AVERAGE BUILDING TEMPERATURE	20 DEGREES C
ECSS SOLAR CONVERSION EFFICIENCY	0.02
ECSS OPERATING ENERGY	0.306 GIGA JOULES
TOTAL SYSTEM OPERATING ENERGY	0.465 GIGA JOULES
TOTAL ENERGY CONSUMED	7.143 GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	N.A.	0.510	N.A.	0.511 GIGA JOULES
SOLAR FRACTION	N.A.	49	N.A.	49 PERCENT
SOLAR ENERGY USED	N.A.	0.247	N.A.	0.247 GIGA JOULES
OPERATING ENERGY	N.A.	0.159	N.A.	0.465 GIGA JOULES
AUX. THERMAL ENG	N.A.	0.263	N.A.	0.263 GIGA JOULES
AUX. ELECTRIC FUEL	N.A.	0.263	N.A.	0.263 GIGA JOULES
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. GIGA JOULES
ELECTRICAL SAVINGS	N.A.	0.136	N.A.	-0.170 GIGA JOULES
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 0.211

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28, 1978. SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: ZEIN MECHANICAL-NO. 1
REPORT PERIOD: OCTOBER,1978

SOLAR/1057-78/10

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	0.700	57	0.000	N	0.011	N	0.000
2	0.546	59	0.000	O	0.009	O	0.000
3	0.483	56	0.000	T	0.008	T	0.000
4	0.184	52	0.000		0.008		0.000
5	0.493	53	0.000	A	0.008	A	0.000
6	0.255	49	0.000	P	0.010	P	0.000
7	0.285	43	0.011	P	0.010	P	0.037
8	0.810	45	0.014	L	0.012	L	0.017
9	0.377	55	0.000	I	0.008	I	0.001
10	0.189	58	0.000	C	0.007	C	0.000
11	0.279	57	0.000	A	0.009	A	0.000
12	0.191	53	0.000	B	0.006	B	0.000
13	0.543	47	0.000	L	0.008	L	0.000
14	0.385	40	0.001	F	0.010	E	0.002
15	0.041	40	0.021		0.004		0.519
16	0.381	42	0.010		0.010		0.025
17	0.637	46	0.019		0.011		0.030
18	0.234	48	0.016		0.009		0.067
19	0.466	50	0.010		0.011		0.022
20	0.783	57	0.007		0.012		0.009
21	0.490	67	0.001		0.010		0.002
22	0.151	58	0.000		0.007		0.000
23	0.558	41	0.020		0.013		0.037
24	0.774	46	0.023		0.013		0.029
25	0.025	50	0.008		0.003		0.318
26	0.464	45	0.006		0.009		0.013
27	0.757	48	0.011		0.011		0.014
28	0.706	43	0.019		0.012		0.026
29	0.506	46	0.021		0.010		0.041
30	0.761	55	0.013		0.012		0.018
31	0.713	46	0.005		0.011		0.007
SUM	14.168	-	0.234	N.A.	0.290	N.A.	-
AVG	0.457	50	0.008	N.A.	0.009	N.A.	0.017
NBS ID	0001	N113			0102		N111

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: ZEIN MECHANICAL-NC. 1 SCLAR/1057-78/10
REPORT PERIOD: OCTOBER,1978

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	0.700	0.682	0.317	66	0.453
2	0.546	0.540	0.244	68	0.446
3	0.483	0.479	0.208	62	0.430
4	0.184	0.142	0.039	55	0.213
5	0.493	0.483	0.206	58	0.417
6	0.255	0.239	0.080	51	0.313
7	0.285	0.266	0.109	48	0.383
8	0.810	0.792	0.369	54	0.455
9	0.377	0.366	0.162	61	0.430
10	0.189	0.182	0.078	61	0.413
11	0.279	0.269	0.108	59	0.387
12	0.191	0.173	0.069	58	0.363
13	0.543	0.524	0.255	57	0.469
14	0.385	0.367	0.153	45	0.398
15	0.041	0.000	0.000	42	0.000
16	0.381	0.366	0.167	47	0.438
17	0.637	0.620	0.286	53	0.448
18	0.234	0.210	0.089	*	0.379
19	0.466	0.453	0.197	56	0.424
20	0.783	0.772	0.378	67	0.482
21	0.490	0.489	0.230	75	0.468
22	0.151	0.142	0.060	65	0.401
23	0.558	0.544	0.243	44	0.435
24	0.774	0.756	0.320	51	0.414
25	0.025	0.002	0.001	53	0.041
26	0.464	0.456	0.201	50	0.434
27	0.757	0.745	0.333	58	0.440
28	0.706	0.690	0.319	51	0.452
29	0.506	0.491	0.205	49	0.404
30	0.761	0.751	0.335	64	0.440
31	0.713	0.708	0.321	52	0.451
SUM	14.168	13.701	6.081	-	-
AVG	0.457	0.442	0.196	56	0.429
NBSID	Q001		Q100		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
STORAGE PERFORMANCE

SITE: ZEIN MECHANICAL-NO. 1
REPORT PERIOD: OCTOBER,1978

SOLAR/1057-78/10

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	0.317	0.000	0.009	98	0.027
2	0.244	0.000	0.017	102	0.071
3	0.208	0.000	0.005	103	0.023
4	0.039	0.000	-0.047	101	-1.196
5	0.206	0.000	-0.041	93	-0.201
6	0.080	0.000	-0.010	92	-0.127
7	0.109	0.011	-0.051	86	-0.375
8	0.369	0.014	0.048	86	0.168
9	0.162	0.000	0.035	94	0.218
10	0.078	0.000	-0.020	93	-0.259
11	0.108	0.000	-0.041	89	-0.382
12	0.069	0.000	-0.011	86	-0.157
13	0.255	0.000	0.037	88	0.144
14	0.153	0.001	0.041	94	0.271
15	0.000	0.021	-0.079	92	1.000
16	0.167	0.010	-0.075	77	-0.389
17	0.286	0.019	0.048	81	0.235
18	0.089	0.016	0.012	86	0.308
19	0.197	0.010	-0.027	80	-0.086
20	0.378	0.007	0.114	88	0.320
21	0.230	0.001	0.052	99	0.229
22	0.060	0.000	-0.045	98	-0.737
23	0.243	0.020	-0.006	99	0.059
24	0.320	0.023	-0.029	90	-0.019
25	0.001	0.008	0.007	94	14.754
26	0.201	0.006	-0.073	85	-0.335
27	0.333	0.011	0.090	89	0.303
28	0.319	0.019	0.043	97	0.192
29	0.205	0.021	-0.058	96	-0.181
30	0.335	0.013	0.023	94	0.108
31	0.321	0.005	0.077	100	0.253
SUM	6.081	0.234	0.042	-	-
AVG	0.196	0.008	0.001	92	0.045
NBS ID	Q200	Q201	Q202		N108

* DENOTES UNAVAILABLE DATA.
& DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE HEATING SUBSYSTEM

SITE: ZEIN MECHANICAL-NO. 1
REPORT PERIOD: OCTOBER,1978

SOLAR/1057-78/10

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX FLECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG TEMP DEG. F	AMB TEMP DEG. F
1	0.000	0	0.000	0.000	0.000	0.000	N	0.000	N	72	57
2	0.000	0	0.000	0.000	0.000	0.000	O	0.000	O	71	59
3	0.000	0	0.000	0.000	0.000	0.000	T	0.000	T	70	56
4	0.000	0	0.000	0.000	0.000	0.000		0.000		66	52
5	0.000	0	0.000	0.000	0.000	0.000	A	0.000	A	67	53
6	0.000	0	0.000	0.000	0.000	0.000	P	0.000	P	66	49
7	0.023	46	0.011	0.007	0.012	0.012	P	0.005	P	63	43
8	0.024	56	0.014	0.006	0.011	0.011	L	0.009	L	66	45
9	0.002	23	0.000	0.001	0.001	0.001	I	-0.000	I	66	55
10	0.000	0	0.000	0.000	0.000	0.000	C	0.000	C	68	58
11	0.000	0	0.000	0.000	0.000	0.000	A	0.000	A	69	57
12	0.000	0	0.000	0.000	0.000	0.000	B	0.000	B	68	53
13	0.000	0	0.000	0.000	0.000	0.000	L	0.000	L	57	47
14	0.002	34	0.001	0.001	0.002	0.002	E	0.000	E	64	40
15	0.043	49	0.021	0.013	0.022	0.022		0.012		63	40
16	0.022	43	0.010	0.008	0.013	0.013		0.004		64	42
17	0.035	55	0.019	0.010	0.016	0.016		0.012		63	46
18	0.038	41	0.016	0.013	0.023	0.023		0.007		65	48
19	0.023	45	0.010	0.008	0.013	0.013		0.005		68	50
20	0.014	51	0.007	0.004	0.007	0.007		0.004		71	57
21	0.003	32	0.001	0.001	0.002	0.002		0.000		71	67
22	0.000	0	0.000	0.000	0.000	0.000		0.000		70	58
23	0.041	50	0.020	0.012	0.021	0.021		0.012		67	41
24	0.043	52	0.023	0.013	0.021	0.021		0.014		68	46
25	0.022	36	0.008	0.009	0.014	0.014		0.002		68	50
26	0.014	44	0.006	0.005	0.008	0.008		0.002		68	45
27	0.020	52	0.011	0.006	0.010	0.010		0.006		69	48
28	0.036	52	0.019	0.011	0.018	0.018		0.011		69	43
29	0.039	53	0.021	0.011	0.018	0.018		0.013		68	46
30	0.026	53	0.013	0.007	0.012	0.012		0.008		70	55
31	0.011	43	0.005	0.004	0.006	0.006		0.002		69	46
SUM	0.484	-	0.234	0.151	0.249	0.249	N.A.	0.129	N.A.	-	-
AVG	0.016	49	0.008	0.005	0.008	0.008	N.A.	0.004	N.A.	68	50
NBS	Q402	N400	Q400	Q403	Q401		Q410	Q415	Q417	N406	N113

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SITE: ZEIN MECHANICAL-NO. 1
REPORT PERIOD: OCTOBER,1978

SOLAR/1057-78/10

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	1822	N	57	66	N	N	N
2	1422	O	59	68	O	O	O
3	1257	T	56	62	T	T	T
4	479		52	55			
5	1285	A	53	58	A	A	A
6	665	P	49	51	P	P	P
7	741	P	43	48	P	P	P
8	2110	L	45	54	L	L	L
9	593	I	55	61	I	I	I
10	493	C	58	61	C	C	C
11	728	A	57	59	A	A	A
12	498	B	53	58	B	B	B
13	1414	L	47	57	L	L	L
14	1002	E	40	45	E	E	E
15	106		40	42			
16	992		42	47			
17	1658		46	53			
18	509		48	*			
19	1213		50	56			
20	2039		57	67			
21	1277		67	75			
22	392		58	65			
23	1452		41	44			
24	2016		46	51			
25	65		50	53			
26	1208		45	50			
27	1972		48	58			
28	1840		43	51			
29	1319		46	49			
30	1981		55	64			
31	1857		46	52			
SUM	36896	N.A.	-	-	-	-	-
AVG	1190	N.A.	50	56	N.A.	N.A.	N.A.
NBS ID	Q001		N113			N115	N114

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